EXTENSION ACROSS VALLES MARINERIS AND THE THAUMASIA "RIFT", MARS. W. Zuschneid[1,2], E. Hauber[1], P. Kronberg[3], and R. Jaumann[1], [1]DLR-Institute of Space Sensor Technology and Planetary Exploration, Rutherfordstr. 2, 12489 Berlin, Germany, [2]Institut für Geologie, FU Berlin, Malteserstr. 74-100, 12249 Berlin, Germany,ewill@web.de, [3]Institut für Geologie, TU Clausthal, Leibnizstr. 10, 38678 Clausthal-Zellerfeld, Germany.

Summary: We calculate the amount of crustal stretching across the Valles Marineris and a large graben structure in the western Thaumasia region (the "Thaumasia graben" [1,2]). We measure vertical offsets in a set of transects using data obtained by the MOLA laser altimeter. Assuming a fault dip angle of 60°, correcting for landslide deposits, but ignoring other sediment cover, we obtain extension values from 9 km in western Ius Chasma to 20 km in eastern Melas Chasma, decreasing toward eastern Coprates Chasma. The Thaumasia graben in the Claritas Fossae region shows extension of 0.5 to 4.5 km. An interpretation and discussion of the results will be given elsewhere.

Method: A set of profiles was analyzed for each area using a Digital Elevation Model (DEM) generated with data from the MOLA instrument. The MOLA data set [3] has a higher accuracy than previous DEMs computed from Viking stereo imagery, occultation data, and Earth-based radar measurements. It is also more accurate than height information from photoclinometry or shadow measurements. Drawbacks of MOLA data are the relatively low lateral resolution (~330 m between data points along track, i.e., in a roughly N-S direction, much wider spacing between data across track, i.e., in E-W direction), *as compared to available image data*. It is, therefore, often ambiguous whether a topographic offset is caused by faults or by other morphologic features, e.g., by impact craters. This problem can partly be overcome by merging MOLA-based DEMs with Viking or MOC image data (Fig. 1 and 2). The extension e was calculated by:

$$e = D / \tan \alpha$$

where α is the dip of the fault and D is the vertical offset along the fault. For all faults, a dip angle α of 60° was assumed [4], sediment cover (which would mask the actual offset, resulting in smaller extension values) was negected. For landslides, however, a correction for their measured thickness was applied to calculate the actual offset.

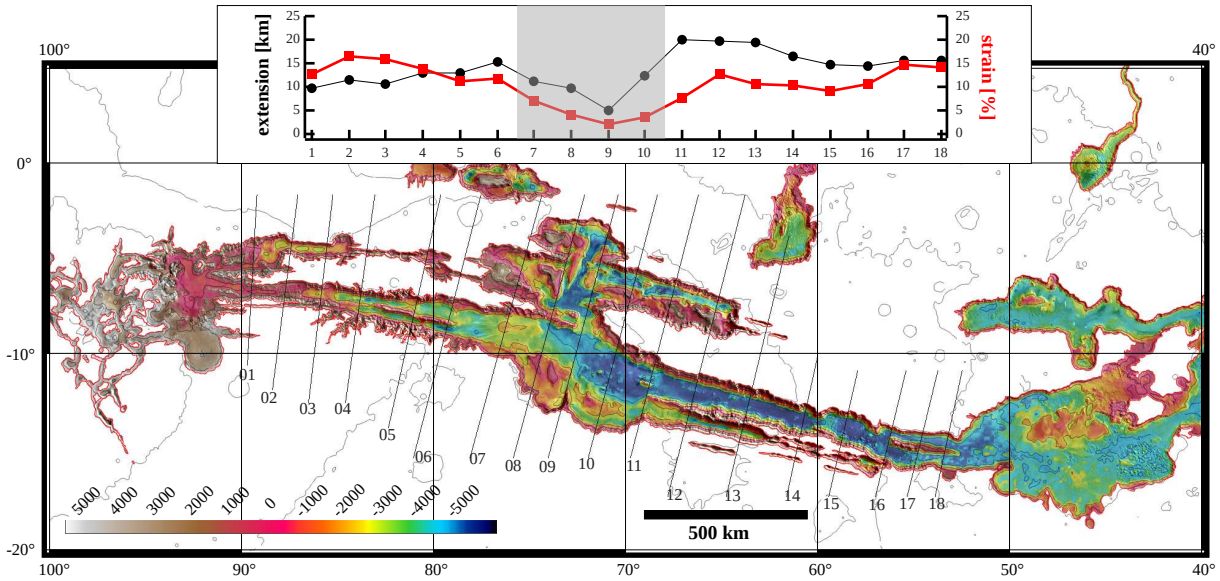

Figure 1: Location of topographic profiles used to calculate extension across the main Valles Marineris trough (Ius, southern Melas, and Coprates Chasmata). Extension is shown in the graph, shading indicates areas where interior layered deposits might bury tectonic structures.

Results: The results (see details below) show that extension across the Thaumasia graben (0.5-4.5 km) is more similar to that across the Tempe Fossae Rift (2.5-3.1 km [5]) than to that across the main Valles Marineris trough (4.9-20 km).

Valles Marineris. We measure extension across the main Valles Marineris trough, including (from W to E) Ius, southern Melas, and Coprates Chasmata [6,7]. For Ius Chasma, the extension increases from 9.8 km at the western end to 15.4 km in the east, with strains of 11 to 16.5%. Strain in Melas Chasma is lower, 2 to 7%. However, the Melas Chasma area is especially complicated to analyze, because the troughs widen considerably and are partially filled with interior layered deposits, making it problematic to define the vertical offset properly. Low strain values in Melas Chasma have also been attributed to structures buried by the interior layered deposits by other authors [8]. Therefore, our values for that area have to be considered with caution (grey shading in the graph of Fig. 1). The low values might support the hypothesis of buried tectonic structures in the central part of Valles Marineris, Melas Chasma. For Coprates Chasma, higher values than in earlier studies have been calculated, with a maximum of 15.6 km and a strain of 14.6% in the east. Generally, our results confirm data published by [9] and [10].

Thaumasia Graben System. The large Thaumasia graben system is one of the most prominent fault-bounded structures on Mars. It is ~100 km wide, >1000 km long, and strikes N15°-20°W (Fig. 1a). In a companion abstract [2], we give a detailed description of its morphology and tectonic setting. In the northern part, a large part of the extension has occurred along few faults. In the southern part of the graben system, extension has been distributed among many smaller faults. Extension in this area is 0.5 to 3.5 km, strain is 1 to 3%, perpendicular to the main axis of the graben. This is much less than 10 km calculated by [11] from scarp widths and shadows. The discrepancy might be due to our more accurate topographic data (i.e., MOLA) or to the problem that it is not straightforward – particularly in the southern part of the Thaumasia graben – to decide whether a given fault belongs to the complex (half)graben system or to an older fault set.

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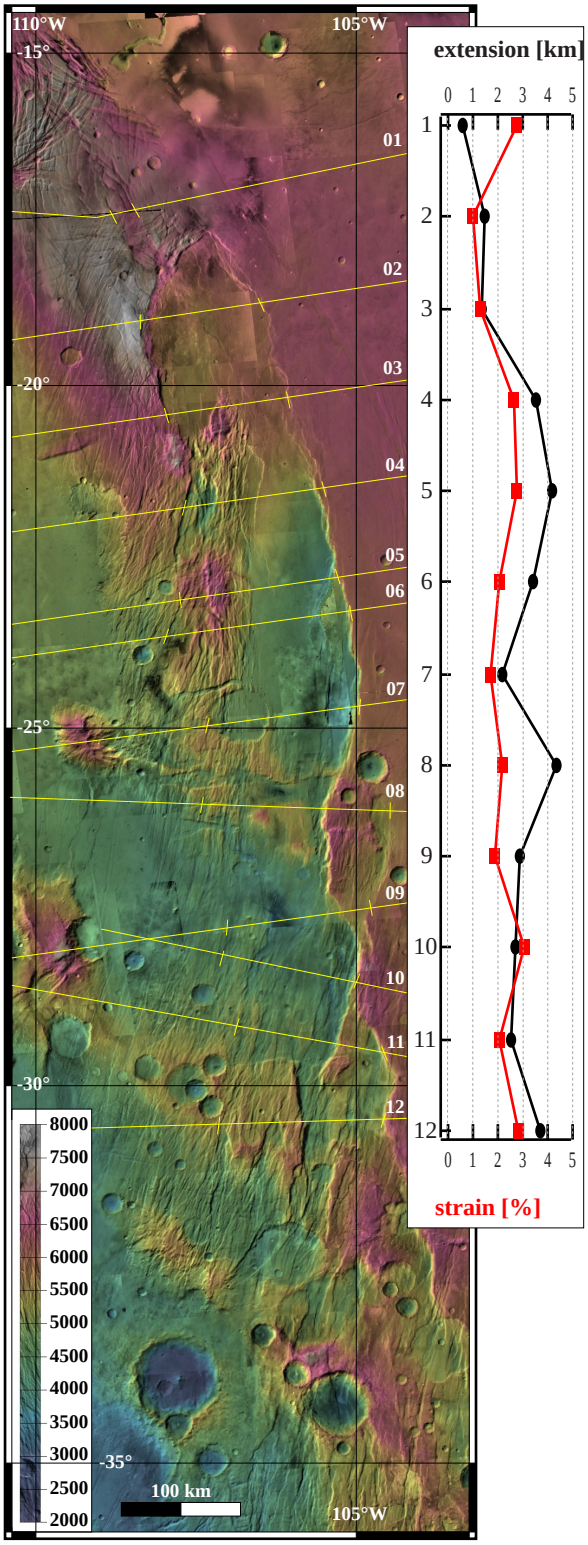

Figure 2: Location of topographic profiles used to calculate extension across the Thaumasia graben.